

T H E S I S

on

ECTOPIA TESTIS in CHILDHOOD

by

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INTRODUCTION.

During the last year I have accepted an opportunity which offered itself of studying cases at the Surgical Outpatient Clinic of the Liverpool Children's Infirmary, who were brought to the Hospital on account of a variety of complaints connected with the genital organs.

It was my intention at first to make a statistical rather than a strictly clinical study of these cases, or, in a narrower sense, of all those in whom some abnormality could be detected in connection with the descent & development of the testicle.

It was soon apparent, however, that any tables based on the cases available would be vitiated in regard to estimating the absolute proportion of such abnormalities in any given number of infants by the fact that so many are brought to the Hospital especially for these deformities. A Maternity Hospital is perhaps the only Institution where such an estimate can be arrived at accurately in regard to the new born, or a mixed clinic where surgical and medical cases are not separated, in regard to Children and Adults.

At first all male children available were examined and though for the reasons given nothing

more than a general impression can be stated, that obtained suggested that delayed descent of the testicle is a common deformity and much more so than is usually supposed. In the first one hundred cases examined in no less than 10 some abnormality in the descent and development of the organ was found. Statistical estimation being abandoned it was possible to study the cases presenting some deformity of the genitals from several points of view. Of great interest and importance are the complications arising in connection with undescended testes, but several of these are almost confined to the periods of adolescence and adult life; for instance new growths and the several forms of trauma.

Ultimately the following proposition was adopted:-

- " How far can delayed descent of the testicle be
- " considered a developmental error and the
- " complications arising in infancy of the same
- " nature. " ?

Several theories have been advanced from time to time to explain incomplete descent. As incidental causes have been suggested (1) Want of development of the Gubernaculum testis (2) of the processus Vaginalis. Can clinical observations bring any

evidence whether the condition is due to causes essentially connected with the testicle and the structures immediately related to it, or to causes more or less outside the organ itself, such as the two above stated. Before such a question can be completely discussed it is necessary to understand the anatomy of the descent of the organ and also *the* comparative anatomy.

In the following essay therefore it is proposed

- (1) To give in outline the most recently ascertained facts connected with these matters.
- (2) To relate shortly the cases collected, dividing them for convenience and for other reasons into classes according to the degree of the deformity.
- (3) To correlate the cases and endeavour to shew the bearings and relations of the various associated deformities and how they affect the answer to the proposition set forth.

During the 1st year the scrotum varies considerably in shape. In a well nourished infant there is usually a large deposit of fat in the inguinal region surrounding the base of the penis. If this is marked the scrotum proper in the contracted condition is represented by a rugose circle of skin divided by the median raphe and the testicles are both

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above the level of this embedded in the fat on each side. In the poorly nourished child on the other hand, in rickets, the scrotum is often large pendulous and flabby and the cremasteric reflex not easily elicited.

In the average child the rugation of the scrotum is very marked & within limits of health the testicles may vary much in position in relation to the bottom of the scrotal bag. When the inner side of the thigh is stroked the scrotum contracts but more noticeable is the very great activity of the cremaster, the testicle being often drawn out of the limits of the scrotum altogether up to the region of the external ring.

In infancy, therefore, there is considerable limit of position within which ^{the testicle} may be said to be normally situated and the exact position depends on temporary circumstances, on the relaxation or retraction of the cremaster. In the retracted condition, however, such normal testicles can be brought down to the bottom of the scrotum without any difficulty.

There is also reason to believe that the level of the descent of the testicle may vary to a certain degree at any given age, and yet that there may be no justification for considering that such

differences are pathological. For instance of two children of the same age the testicles of the one may in the relaxed condition of the scrotum reach the apex, while those of the other may show no abnormality on the most careful examination either in respect of the testicle itself or the canal or ring to warrant a conclusion that we have to do with a departure from health.

There is a limit, however, beyond which the position may not vary in health. It is agreed that a testicle retained within the inguinal canal and resisting manipulations to bring it down into the scrotum is abnormal.

It is here maintained that a minor degree of retention and delay, cases where the position of the testicle is immediately external to the ring & which may be termed cruro-scrotal, are to be looked upon as calling for, if no operative interference at anyrate a careful examination for concomitant deformities which may be present. The conditions accompanying these minor degrees of delay will be indicated in the course of this article and their frequency is the chief argument for considering the cruro-scrotal position of the testicle abnormal & indicative of a late development.

The Essay is sub-divided as follows:-

- (1) As above stated the cardinal points of the comparative & human anatomy of the Testicle and the structures concerned in its descent are considered.
- (2) The Clinical records collected by the writer are given in detail and commented on.
- (3) The facts thus elicited are made use of in a discussion on the structural peculiarities of the Ectopic testis.
- (4) An attempt is made to show that abnormalities in descent are capable of throwing light on the normal migration of the testicle.
- (5) The causes of arrested descent of the Testicle as indicated by the Clinical records are discussed.

This arrangement appears to the writer the natural one to follow.

(I) THE ANATOMY of the DESCENT of the TESTICLE.

There is no organ in the body at all comparable to the testicle in the changes in position which it undergoes, whether looked at from the point of view of comparative anatomy or of human embryology.

COMPARATIVE ANATOMY.

In the Elephant Rhinoceros, the Whale, Walrus, Seal and some other animals the testes are situated in the abdomen throughout life. Among mammals, however, these form the exception; in the great majority at one time or another either permanently or periodically the testicles are extra abdominal and occupy a special pouch, the scrotum.

In some this position as indicated is only periodical; during periods of sexual activity, i.e. during what is called the "rutting season", they pass into the scrotum to resume their abdominal position when this season is over. During the period of functional rest the seminal tubules, as such, disappear and their place is occupied by solid columns of cells (in other words the lumen of the tubules disappears) the whole organ becoming much smaller and the peculiar function of the cells, the production of spermatazoa is in abeyance.

It would appear, therefore, that the scrotal position is in some animals periodically necessary

for full physiological activity, and when in these there ^{is} ~~are~~ a degree of retention, when for instance the testicle which should be scrotal is arrested in the inguinal region, or in the abdomen, this full physiological activity is not attained. Again in those animals in which the testes is permanently scrotal, & there is no periodicity, it appears for some reason, that if they are to be active they must reach the terminal of their descent and that arrest is accompanied by a degree of incompetency and degeneration.

Griffiths has described these degenerative changes in the testicles of dogs arrested in descent, and also has shewn that similar alterations in structure can be experimentally produced by operative replacement of the testicles of puppies into the abdomen.

x Journ. of Anat.
& Phys.
Vol. 28. p. 209

The ANATOMY of the DESCENT of the TESTICLE in MAN.

The body of the Testicle has its origin in the genital mass which lies to the front and outer side of the Wolfian Body in the human embryo, and in front rather to the outer side of the Kidney. About the 6th week of intrauterine life the definition

between genital mass and Wolfian Body is distinct and the Wolfian Body has a well marked mesentery.

The genital mass becomes converted into a highly complicated tubular organ. About the 10th week the mass has the general contour of the developed testicle and the Wolfian Body resembles the epididymis and both epididymis & Vasa efferentia are derived from the latter.

MESORCHIDIUM.

The above mentioned mesentery of the Wolfian Body is attached to the wall of the abdomen external to the kidney and becomes more and more distinct to form the Mesorchium. At the third month it possesses well marked ascending and descending processes, the Plica Vascularis (Lockwood)^{*} and the Plica Gubernatrix. By the gradual longitudinal growth of the foetus the testicle becomes more and more separated from the kidney and at the 7th month the mesorchium has important relations to the Coecum and Sigmoid Flexure above, and the true Gubernaculum below, and the pouch which is the beginning of the Processus Vaginalis.

* Journ. Anat. & Phys.
Vol. 22 p. 505.

THE PROCESSUS VAGINALIS.

Long before the testicle begins its true descent into the scrotum, ^{the} Processus Vaginalis has been

forming. It appears about the 3rd month (Kolliker)

x
Entwicklungsgesch.
p. 994.

The Plica Gubernatrix projects from its floor, traced upwards it receives cremaster fibres from the innermost layer of abdominal muscles. The appearances favour the theory that the process is produced by traction applied to its pointed extremity. Later than this the process precedes the testicle into the scrotum and though at the time when the Processus first appears the Gubernaculum has no definite power of contraction yet it is difficult to say when tissues are first capable of contraction and it is not necessary perhaps to conceive of active contraction.

Carus's theory that the testicle carries down coverings for itself from the abdominal wall has been shewn incorrect by many observers from the time when ⁺Sappey argued against it (1874) onwards. As early as the 10th week at a point (which corresponds with that of the future internal abdominal ring) the external abdominal layer of the wall makes a bend in the direction of the scrotum, representing the beginning of the descending portion of the cremaster and a deficiency in certain muscular fibres in the position of the future canal indicate its site. There is at this period no indentation of the Peritoneum.

x
Traité d'Anat.
descrip.
vol. 4. p. 581.

At the 5th month the testicles still lie in contact with the abdominal wall, but the Gubernaculum and the Processus Vaginalis are definitely marked. The External Spermatic Fascia and the descending Cremaster are well marked in the scrotum which they have reached without any trace of traction.

The GUBERNACULUM.

The opinions on the nature and functions of the Gubernaculum have been many, Its early superior attachment is to the genital cord which contains the Wolfian and Mullerian ducts and runs inwards to join with its fellow of the opposite side. Later if its course of development is normal it obtains attachment to the epididymis & testicle. The muscular structure of the Gubernaculum is undoubted. Its lower attachments have been worked out by

* Curling by the method of dissection, and by * Lockwood in histological sections. They become progressively more complex as the foetus develops.

At first the fibres end in (3rd month) the descending cremaster and the external spermatic fascia. At the 5th month the fibres are spread out fanlike towards Scarpa's triangle, towards the root of the penis and towards the scrotum. At the 6th month a process passes into the perineum. These

* Journ. Anat & Physiol. vol 22 p. 519.
* Curling Pract. Treat. on Diseases of Testicles. p. 17.

processes are not always constant, and of them the pubic and scrotal are the most so.

In addition to the upper attachments of the Gubernaculum mentioned it also sends a prolongation upwards behind the testicle in the Plica vascularis to be attached to the peritoneum in the coecal or sigmoid region; and doubtless bring about the locomotion of the peritoneum which is seen in the transition of the testicle and in many cases of hernia. The main interest of the plica vascularis depends upon its relation to undescended testis, and the various forms of congenital hernia.

The transition of the testicle may have influence on the last stages of migration of the coecum.

The STAGES of MIGRATION.

With regard to the stages of migration, as stated above the Gubernaculum has at first no attachment to the testicle direct, it is said by some authors that between the 3rd & 4th months the testis ascends from its position in close proximity to the internal ring and rises to a certain degree; it is during this period that the gubernaculum obtains its attachment to the body of the testicle; its lower attachments being to the abdominal wall in the region

of the external ring. The vaginal process has a depth of about one millimetre at the 4th month. During the 5th month no particular change takes place, but towards the end of the 6th month the Gubernaculum enlarges much⁺ (Brammann), from the external inguinal orifice a bundle of fibres can be traced whose lower attachments are to the pubic spine and the tendon of the External Oblique: it is reinforced by fibres from the Internal Oblique. The true descent begins at the end of this month: the testicles 8 millimetres distant from the ring approach it, the gubernaculum shortens and the Vas deferens becomes more horizontal. The Vaginal Process~~e~~ enlarges and deepens: according to⁺ Bramann no muscular fibres are traceable from the sac to the bottom of the scrotum. In the 7th month the testicles enter the canal and the left usually before the right, and the Vaginal process~~e~~s descends before them.

During the 8th month full descent into the scrotum of the testes is completed; the part played by the various structures concerned in this descent is considered in a later chapter.

⁺Arch. f. Anat.
u. Entwickel.
Gesch. 1884.

⁺loc. cit.

(II)

CLINICAL RECORDS

Bilateral Cryptorchism is recognised to be a rare condition. * Jacobson for instance states that he has only met with one example after puberty. Only one case is included in the following Clinical Records in a child aged 4 months.

x Diseases of the
Male Organs of
Generation.
p. 30.

There are on the other hand 7 cases of unilateral Cryptorchism, at ages ranging from 3 weeks to 10 years, the average age being about $2\frac{1}{2}$ yrs. It is stated by * Ashby & Wright that in many cases the testicle retained at birth comes down into the scrotum within the first two years. This observation if correct does not affect this first table except as regards case 4 and here the whole genital apparatus is so markedly abnormal that there is no doubt as to the Ectopia being due to arrested development.

x Diseases of
Children. 5th Ed.
p. 536.

In table II, the inguinal cases, there are four under two years (one being a year & 10 months old) and in table III, cruro-scrotal cases, there are six such cases. Out of a total therefore of 34 cases eleven only are under the age of 2 years.

If the observation of Ashby & Wright is correct there should be a preponderating number of cases below the two years limit, so that their statement derives no support from the writer's observations

This is a further argument against the view which inclines to look upon Ectopia in infancy and childhood as a matter of little importance and one which will right itself without complication in the great majority of cases.

In the records here given no case has been included where there was any doubt as to the reality of the deformity; cases for instance where the condition was simply one of retraction, and where the organ could easily be persuaded to come down by traction were always discarded.

The position indicated by the term Cruro-scrotal is one immediately external to the ring; the Inguinal position is spoken of when the organ is in the canal; and the term Cryptorchism is used when the testis cannot be found and is presumably retained in the abdomen.

The tables represent the results of the examination of upwards of 300 cases, but the number in which ectopia was present cannot be considered the average among 300, as the latter represent infants suspected to have some such condition and chosen and examined for the purpose of discovering it. Nothing therefore can be said about the absolute frequency of the condition though the impression gained is that it

is far more common than is usually supposed.

COMPLETE CRYPTORCHISM.

1. T. T. aet 4 months.

Neither testicle can be felt, and the case is one of complete retention in the abdomen.

The penis is well formed. Scrotum small. There is no external ring to be felt.

Child was brought to the Hospital on account of marked bulging of the lower abdominal walls on each side. The walls are very lax and thin. There is no other deformity.

UNILATERAL CRYPTORCHISM.

	Name.	Age.	Right.	Left.	
1.	H. G.	2 yrs 7 3 mos 27 mos	Retained	Scrotal	no deformity.
2.	S. E.	3 yrs	Normal	Retained	Scrotum bifid
3.	M. K.	3 yrs 7 8 mos. 44 mos	Retained, Epididymus at ring.	Normal	no deformity
4.	C. B.	3 wks	Inguinal, small.	Retained	Perineal Hypospadias Bifid Scrotum
5.	T. R.	2 yrs	Normal	Retained	no deformity
6.	A. T.	10 yrs	At inter- nal ring.	Normal	"
7.	J. H.	3 yrs	Normal	Retained	"

1. H. G. aet 2 years & 3 months.

The right testicle is retained in the abdomen. The left is scrotal and normal. The child has rickets but no deformity.

2. S. E. aet 3 years.

The left testicle is retained. The right is scrotal and normal. The scrotum is peculiar, laterally it is extended as a well marked fold on each side, these meet above over the symphysis pubis encircling the base of the penis.

3. M. K. - aet 3 years & 8 months.

The left Testicle is normal and fully descended. On the right side just external to the ring there is a small mass which on careful examination appears to be epididymis: to it a cord is attached which proceeds upwards ~~upwards~~ to enter the inguinal canal and is apparently the vas deferens. No body resembling the testis is present.

4. C. B. - aet 3 weeks.

The left testis is retained. The right is in the inguinal canal, is very small and soft, the epididymis is felt below it. There is perineal

hypospadias with bifid scrotum and the child was brought to the Hospital in order that its true sex might be ascertained. A week later it was brought again with an abscess in the region of the right testis. This was simply incised and healed rapidly. There was no change in the position of the testis 3 months later.

5. T. R. - aet 2 years.

The left Testis is completely retained. The right is fully developed and in the scrotum. The child is well developed but has a dull apathetic expression.

6. A. T. - aet 10 years.

The left testis is in the scrotum and of good size. The right is not to be felt. The mother says that at times especially after a hot bath a lump appears in the inguinal region and the boy complains of tenderness and aching pain. This boy was admitted to hospital where I was fortunate enough to be able to see the further course of the condition.

He was operated on on March 14th and I have to thank Mr Keith Monsarrat for permission to use the notes taken at the time. An incision was made over the course of the inguinal canal and the fascial and

muscular layers in front of this opened. A processus vaginalis was found which reached the position of the external ring which was patent. A fold stood out from the posterior wall of the process and stretched from its lower extremity upwards; by pulling on this a testicle was brought into view: its position being apparently at the internal ring. The fold was attached to its lower and posterior aspect and from this a second small fold stretched in a downward and inward direction towards the pubic spine. The epididymis was not intimately connected with the testis but was situated above and to the inner side. When the testis was pulled down a retaining fold above, containing the vas deferens & vessels was made taut and when first handled this prevented the organ being brought further down than the outer ring.

7. J. H. - aet 3 years.

The left testicle is completely undescended. The right is normal and in the scrotum. There is no other deformity.

Considering these seven cases together we find that in four the left testicle was that chiefly concerned, and in three the right.

Of the latter only one (1) there was no sign of the testicle or of any preparation for its descent, while the other organ was normal in every respect.

In the remaining two certain stages of the migration had progressed.

Case 3 is remarkable in that although a structure indistinguishable from epididymis and vas deferens was clearly to be made out at the external ring , the testis itself was not to be found even in the canal.

The condition of the processus vaginalis could not be investigated in this as in case 6. In this case 6 there was a definite

P.T.O.

attachment to the testis and the processus vaginalis was well formed and in advance of the testis (~~some cause other than that assumed in the last case must be found to explain this~~). In the condition of affairs found at the operation, the upper attachments, the plica vascularis resisted downward traction and the parts had evidently settled down in this condition though the history shewed that there was a certain amount of natural mobility, noticed by the mother when the parts were in a lax condition produced by a warm bath. The testis was well formed, \S so that the theory which has been propounded in some quarters that the incomplete descent is due to deficient reflex stimulation of the parts, the gubernaculum especially, by an undeveloped testicle is unable to explain the state of affairs \S . Though too much importance cannot be attached to the condition of the plica vascularis as found at aet. 10 years in respect of its possible role in the migration, still the most probable explanation seems to be in this direction. The importance of the superior attachments of the gubernaculum fall to be considered in ^{a later} Chapter \S .

Of the four cases in which the left testis was undescended, in three there was simple retention with no concomitant deformity, the organ on the right

side being in position and normal. In case 4 along with complete retention of the left there was retention of the right in the lower part of the canal. In addition this organ was small, the size of a pea & soft accompanying the condition was a bifid scrotum and perineal hypospadias. ¶ There can be no hesitation in assuming here a condition of general developmental arrest affecting all the genital organs: and an imperfect differentiation of sex; the position of the testes is but an incident in this arrest of development and the whole has an origin in the early processes of the evolution of the genital mass and Wolfian Body. ¶

Table II

INGUINAL CASES.

	Name.	Age.	Left site	Right	Hernia	Hypospadias.	Scrotum	Relative size of testes.
1.	A.R.	10 wk	Normal	Inguin	R Bubonocele			
2	R.D.	11 mos	Ring	"		Penile	small	
3	E.R.	2 yrs	Inguinal	Normal				
4	H.B.	3 yrs	Normal	Ing.	R. Bubonocele			
5.	R McD.	3 yrs	Ing.	ing.	R. Bubonocele		small	
6	W.R.	5 yrs	Ing	N.	R Scrotal			
7	A.B.	22 mos	Ing	Ring	Double	E less than D	L side less than R	Left testis is smaller than Right
8	T.S.	8 wks	N	Ing		Glandular	E side less than D	Right testis smaller than Left
9	J. P	5 yrs	Ing	N	L scrotal			
10	T.T.	8 yrs	N	Just within ring		left hydrocele.	E side less than D	Right testis smaller than Left

INGUINAL CASES.

1. A. R. aet 10 weeks.

The left testicle is in the scrotum and normal. The right is in the inguinal canal and cannot be brought down by traction into the scrotum but to just outside the external ring. There is a congenital Right Inguinal Bubonocoele.

2. R. D. - aet 11 months.

The right testicle is in the inguinal canal. The left testicle is at the outer ring and cannot be brought down into the scrotum. The latter is small and there is penile hypospadias.

3. E. R. - aet 2 years.

The right testis is completely descended. The left is in the inguinal canal. No concomitant deformity.

4. H.B. - aet 3 years.

Left testicle descended, the Right is situated at the apex of a bubonocoele. No other deformity.

5. R. McD. - aet 3 years.

Both testicles are in the inguinal canal. The scrotum is small and imperfectly formed. There is a right inguinal bubonocoele.

6. W. R. - aet 5 years.

The Right testicle is completely descended
The left testicle is in the inguinal canal but by
traction can be brought to the external ring. There
is a right scrotal hernia.

7. A. B. - aet 1 year & 10 months.

The right testis is just external to the ring.
The left testicle is in the inguinal canal. There
is a hernial protrusion on each side down the canal.
The left testis is smaller than the right and the left
side of the scrotum is small and undeveloped.

8. T. S. - aet 8 weeks.

The left testicle is in the scrotum and is of
good size. The right testicle is in the inguinal
canal but can be brought to the external orifice by
traction; it is very small and soft. There is a
glandular hypospadias.

9. J. P - aet 5 years.

The right testicle is fully descended and
normal. The left testicle is in the inguinal canal
well above the lower extremity of an inguino scrotal
hernia.

10. T. F. - aet 8 years.

Right testicle very small, half the size of the left, and soft, retained just within the ring. Left testicle is ~~below~~^a the level of ~~the~~ vaginal hydrocele.

In all these cases with one exception (case 3) we have concomitant deformities. In three cases the retention is bilateral but in two of these one testicle is lower than the other: in all three we have also bilateral deformities as follows;-

- " 2." Penile hypospadias & small scrotum
- " 5." Undeveloped scrotum
- " 7." Double bubonocoele.

Hernia is the deformity in six, and the only deformity in those four of these where the retention is unilateral (1. 4. 6 & 9) In only one case where there ~~was~~ a unilateral retention was there a unilateral concomitant deformity. (case 8)

In three of the cases the retained testis is smaller and softer than its fellow.

In cases 6 & 10 the concomitant deformity is on the side opposite to the arrested organ. As will be seen in the following series this occurs too frequently for the opposite complication to be consider-

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-ed an accident.

The three cases of hernia (1, 4, & 9)where the hernia is on the same side as the retained testis, are similar except that in case 9 the hernia reaches below the testis and in the others the latter is situated at the apex of the former.

With regard to the processus vaginalis in the cases where its extent was indicated by the presence of a congenital hernia with one exception (case 9) this was bounded by the external ring, that is to say there was no scrotal extension of the process.

In the one exception there had been a hernia since infancy and the child was 5 years old so that we may assume the processus had been pushed downwards in front of the hernia.

With regard to case 6 where there is a right scrotal hernia opposite a left retained testis: it is possible that the right testis had been pushed down in front of a descending hernia and ~~that~~ originally the right testis also was arrested in descent.

CRURO-SCROTAL CASES.

1. J. F. - aet 1 year.

The left testis was found above the scrotum near the ring, and it was distinctly smaller than the Right, which was in the scrotum and fully developed. The left half of the scrotum was small and undeveloped. There was a Right Scrotal Hernia.

2. A. M. - aet $2\frac{1}{2}$ years.

In this case neither of the Testes had reached the scrotum, but were on the same level just below the external abdominal rings.

There ^{were} ~~was~~ no deformities.

3. W. B. - aet 10 months.

The left testicle was just below the external abdominal ring. The right was in the scrotum: they were of equal size. There was a double Inguinal Hernia. The child had worn a truss from the age of 6 weeks.

4. J. M. - aet 2 years.

The left Testis was to be felt just outside the external abdominal ring. The Right Testis was found in the upper part of the scrotum and could with ease be drawn down into the scrotum: and moreover could be drawn fully an inch into the perineum.

5. A. T. - aet 4 years.

There was marked inequality of the level of descent on the two sides. The left Testis was just entering the scrotum, whereas the Right was descended. There was a left Ing Hernia.

6. R. M. - aet 2 years.

The left testis was outside the External Abdominal Ring. The Right was in the scrotum. With pressure the left could be brought into the scrotum; and it was smaller than the right. There were no associated deformities.

7. T. J. - aet 2 yrs & 8 months

In this case the right testicle was at the ring and the Left Testicle in the scrotum; there was nothing else abnormal to be detected.

8. H. A. - aet $2\frac{1}{2}$ years.

Neither of the testes had fully descended into the scrotum. The Right was at the external ring and could not be brought down. The left was at the top of the scrotum but could be drawn to the bottom of it. The scrotum was very small and undeveloped. The child during the examination

was in great abdominal pain from constipation which might account for the position of the left testis.

9. J. N. - aet 3 years.

Both testes were just outside the ring and excepting that the scrotum was small there was no other abnormality.

10. G. S. - aet 2 months.

Neither testicle had descended into the scrotum. The Right was at the higher level of the two and was at the external abdominal ring. The left was between the ring and the scrotum and was more moveable, they were equal in size. There was a Double Inguinal Hernia, and the child had marked Talipes Calcaneus.

11. J. C. - aet 2 years.

Both testicles were at the external ring, the Left appearing to be a little lower than the Right & both were equal in size, but quite small and soft. There was a penile hypospadias and the scrotum was small and undeveloped.

12. T. S. - aet 7 months.

In this case there was very little abnormality

to be found. The left testicle had descended into the scrotum. The right was some distance from the ring about to enter the scrotum.

13. J. H. - aet 1 year & 2 months.

The left testicle was at the ring; the Right was in the scrotum; there was a Right Inguinal Hernia, and an Unibilical Hernia.

14. D. D. - aet 4 years.

Both testes were at the top of the scrotum just entering it, and they could with difficulty be brought into it. The scrotum itself was very small. There was genu valgum otherwise no abnormalities.

15. R. S. - aet 2 weeks.

Both testicles were just outside the external ring, they were equal in size. The child was born at the 7th month.

16. J. R. - aet 6 years.

The Right testicle was at the external ring & was very small and soft compared to the left which is in the scrotum and below the level of a left Vaginal Hydrocele.

17. E. S. - aet 10 months.

Both testicles were a little below the level of the external abdominal rings and they could not be pulled into the scrotum. They were equal in size but were small and very soft. There was penile hypospadias and an Unibilical Hernia.

CRURO-SCROTAL CASES.

Table III

	Name.	Age.	Left T.	Right T.	Hernia.	Relative size of T.	Scrotum	Deformities.
1.	J.F.	1 yr	at ring	N.	R.Scrot	R larger than L.	R side larger than L.	
2.	A.M.	2½ yrs	"	at ring			small	
3.	W.B.	10 mos	"	N	Double			
4.	J.M	2 yrs	"	N.				
5.	A.T.	4 "	"	N.	L.Ing			
6.	R.McL	2 "	"	N.		R larger than L.		
7.	T.J.	^{2 yrs 7 8 mos} 2 mos	Normal	at Ring				
8.	H.A.	2½ yrs	"	"			small	
9.	J.N.	3 "	at Ring	"			small	
10.	G.S.	2 months	"	"	Double			Talipes Calcaneu ^m
11.	J.C.	2 ^{years}	"	"		small soft	small	Hypospadias
12.	T.S.	7 mos	Normal	"				
13.	J.H.	14 "	at Ring	Normal	R.Ing			
14.	D.D.	4 yrs	"	at ring				
15.	R.S.	2 wks	"	"				7 mos child.
16.	J.R.	6 yrs	Normal	"		R small & soft		L. vag Hyd.
17.	E.S.	10 ^{months} mos	at ring	"		Both small		Hydospadias

In the table:- " At the Ring " includes those cases described in reports as anywhere near the ring but external to it.

It is at once seen on glancing at this table that compared with the last, concomitant deformities are much less common proportionately when the descent is more advanced.

We have eight cases here where the comparative arrest in descent is the only abnormality present with the exception that in two of these the scrotum was somewhat undeveloped.

The ages of these children varied between two weeks and four years, the average age being nearly two years. One was a seven months child two weeks old.

In three the condition was bilateral, in five unilateral.

In nine cases there was some other abnormality the most common being a departure from the normal in the size or consistence of the testes, when unilateral always affecting the undescended organ.

Of the five cases where hernia was present in two the hernia was on the side opposite the undescended organ; in one on the same side, and in the remaining cases the rupture was double; left vaginal hydrocele.

was found once opposite a right retained testicle small and soft.

The two cases with hypospadias presented a condition of comparative arrest of the testis on both sides and the organs were in both cases small & soft.



THE CONDITION of the ECTOPIC TESTIS.

In a certain number of ^{the} cases of Ectopia here recorded a difference in size and consistence between the testes was easily appreciated on examination. A reference to the tables shews that of the 10 where the Ectopia was inguinal three exhibited this inequality; in each case it was well marked.

In case 7, Table II, the left Testicle was in the inguinal canal, the right was cruro-scrotal, & the left, the one whose descent was the more incomplete was the smaller. Cases 8 & 10 exhibited the same inequality and in each the retained organ was smaller than that whose descent was complete. The proportion in this table of such inequality is then 3 in 10.

In Table III the cruro-scrutol cases, there are five cases which have relation to the matter. In cases 1, 6 & 16 the Ectopia was unilateral and the Ectopic organ smaller than that on the opposite side; in cases 11 & 17 both testicles were in the cruro-scrotal position and both are small and soft.

In all these cases the abnormality was well marked, small differences and departures from the apparently normal size and consistence were not noted.

It appeared important to discover whether

any particular significance is to be attached to them when found in cases of Ectopia, and whether if they are found in the absence of Ectopia that they are usually associated with any other deformity.

The following table was constructed from the notes made on all the cases examined during the investigation of the subject of the essay.

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To sum up this table in all except five cases there was some other deformity associated with the inequality in the testes and one of these five was the subject of a double harelip. In the 12 cases there was either hernia or hydrocele with one exception where there was hypospadias. In two there was hydrocele on the same side as the small testicle. In five there was a hydrocele or hernia on the side opposite the smaller testicle, and in four cases there was a double hernia.

It is not possible to draw many conclusions from the table but it would appear:-

1. That inequality in the size and consistence of the testes is not uncommon.
2. That it is in the great majority of instances associated with abnormalities of the processus vaginalis.

Probably slight differences are of no significance and only the cases of marked inequality should be really considered departures from the normal, and I am inclined to think that in the cases where the smaller testicle has a hernia or hydrocele opposite to it, it is probably the case that the opposite testicle is larger because of the condition of congestion of the spermatic vessels produced by the pressure of the

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hernia or hydrocele and not that one testicle is developmentally smaller than the other.

Taking separately the cases where the inequality was noted as very marked we have:-

J.P.	17 days	Right	R.Vag. Hydrocele
T.B.	3 weeks	"	"
J.C.	3½ yrs	"	Hypospadias
W.B.	20 mos	Left	Double Ing Hern.
H.W.	5 mos	Right	"
E.P.	5 yrs	Left	Right Ing.H.Hypospadias.

Here all the cases are associated with an abnormality, and in the closure of the processus vaginalis with one exception where there was hypospadias.

As far as our knowledge of the process goes this closure cannot be conceived of as dependent on the full development of the testicle but the two processes are associated & the evolutionary stimulus of the one must be conceived of as intimately connected with that of the other. When therefore we find maldevelopment of both associated we are justified in assuming that they are mutually significant and that to a certain deficiency in the evolutionary and developmental stimulus common to both is to be ascribed the state of affairs found.

We arrive then at the fact that inequality of the testes is in cases that are well marked to be considered due to developmental and not accidental causes and is usually associated with irregularities in the processus vaginalis.

In the cases of Ectopia in children irregularities are not by any means constant: in fact the great majority of inguinal & cruro-scrotal cases ~~show~~ no difference in size between the two organs that is appreciable. The condition of the abdominal retained organ could not be investigated by the writer. All that can be said is that in every case where the difference was marked it was the organ affected as to its descent that was affected as to its size and consistence.

Other writers have found these alterations as to size and consistence more constant. *Follin states that in every case of Ectopia he had examined whether the organ was at the ring or in the canal, he had always found a marked diminution in size. *Godard & Curling are also in agreement with this observation.

* Arch. de Méd.
XXVI p. 265-

* Etud. Sur la Monopel.
et la Crypt. chez l'
homme. Soc. de
Biol. 1856.

The writer was not able to make a microscopic examination of any of the cases as in none was castration called for, but the opinions of modern

writers on the peculiarities of the structure of the Ectopic testis are fairly uniform. Although Curling maintains that because a testicle is retained its uselessness must not be inferred, yet the majority of such organs microscopically examined have exhibited a marked departure from the normal. For obvious reasons most of these have been from adult cases, castration being rarely called for in childhood and infancy. *Griffiths for example gives the results of the microscopic examination of four adult ectopic testes: all from the inguinal region. Generally the seminal tubules are much reduced in size, and the intertubular connective tissue relatively increased. The tunica propria of the seminal tubules is thickened and the cells of the tubules reduced in numbers & abnormal in shape and disposition. Evidence of Spermatogenesis ~~genesis~~ was absent in every case.

* Journal Anat. & Physiol.
Vol. 28. p. 214

* Monod & Arthrand in adult cases found always a condition of peritubular sclerosis and atrophy of the glandular structure, but considered that in the earlier stages of retention, that is to say up to and about puberty the alterations in the organ were not marked.

* Étude des Altérat.
d Testic Ectop.
Arch. G. de Mors. 1887
p. 637.

Others, however, before puberty & even in childhood have described changes, & the later observa-

tions uphold this view.

^x Griffiths describes the structure of a testicle removed from a boy aged 12 from just outside the external abdominal ring: the seminiferous tubules were small, the tunica propria somewhat thickened and the tubules widely separated.

^x loc. cit.

^x Bezançon records an observation on the inguinal testis of an infant aged one year. He found (α) a slight predominance of the intertubular tissue which is of embryonic structure (β) an appreciable diminution of the calibre of the tubules and of the size of the seminal cells compared with the opposite and normally situated organ.

^x Etude d'l'ectop.
Testic. 1892.
p. 25

But these comparative changes become more marked as we consider the observations on subjects later in life. The Ectopic organ appears to make a certain effort towards full development, to fall short of this but not always very far short, and during adult life it undergoes definite degenerative changes.

The integrity of the testis depends on the age of the subject but the ectopic organ would appear never to attain the degree of development shown by the normal organ at any given age and at some period sooner or later after puberty definite degenerative changes set in. These observations are true

whether the organ is retained in the abdomen, inguinal canal or in the cruro-scrotal position.

(IV)

THE CAUSE of the DESCENT of the TESTICLE.

It should be possible to throw some light on this still debatable question by a study of the conditions in cases where the descent is imperfect.

It has been seen that in certain animals the descent of the organ occurs periodically during functional activity, and also that in man the weight of evidence shows that this is a necessity for the performance of its natural functions and that otherwise it is degenerate and functionless.

The view of ^xMr Bland Sutton that the descent is a perpetuated pathological condition, a hernia, is quite incapable of explaining these facts and especially those relating to the comparative anatomy. On the other hand they indicate that the descent is a vital process provided for in the course of evolution, the necessity for which though not explained is proved by the facts. No theory that seeks to find one single cause for the descent appears to be capable of fitting in with all the facts. Undoubtedly while the organ is intra-abdominal the growth of surrounding organs determines its position.

x Introd. to Gen. Path.
p. 374.

Its seat of origin is posterior near the brim of the pelvis: the organs in front maintain its posterior position, it becomes separated from the kidney by the growth of the lumbar spine and possibly

the coecum & sigmoid flexure may exert some pressure from above and maintain its position opposed to the wall of the abdomen in the region of the internal ring. But none of these circumstances are capable of influencing the further descent and are probably even taken together not to be looked upon as essential causes of the testicle attaining its position at the inner ring.

We are it seems no more in a position to explain the actual cause of the chain of circumstances, the descent, the formation of a processus vaginalis and the disposition of the walls of the canal than we are to explain the cause of the position of the rectum, the proctodeum, the process of union by which a channel is formed. Even if we assume active contractive efforts on the part of the gubernaculum the structure is only one item in a scheme and does not bring the testicle into the scrotum in spite of itself, but according to a law unexplained, that evolutionary & vital processes have decided that the scrotum is the position for the testicle in certain animals periodically, and in others permanently.

There is no convincing evidence to shew that the processus vaginalis is formed by the activity of muscular fibres, its formation is a vital act sui

generis; and equally there is no warrant for conceiving that the descent of the testicle is a process done against resistance, and to conceive of the gubernaculum as having been evolved for the purpose of doing this work against resistance. The gubernaculum according to the view of Curling is the cremaster of adult life; in the transit of the testicle it undergoes the same change as that which takes place in the Rodentia at the access of sexual excitement, its muscular fibres being everted, until when the transit is completed it forms a muscular envelope external to the process of peritoneum which surrounds the gland and the front of the cord "

(Jacobson) It is therefore probably a muscle in course of development. It is certain that it may act at least as a guide to the testicle in the process of transit, the cases of perineal & pubic displacement are evidence of this but according to the view here suggested its importance has been exaggerated as an active and essential factor in the transit; the descent of the organ should not be looked upon as a process of dragging down by a muscle developed for the purpose but on broader lines as a vital process, by which the organs reach the position which has been assigned to them by evolutionary laws,

the gubernaculum being an incident in the process.

* Cleland has attempted to explain the scrotal position of the testis as due to its peculiar requirements of blood supply. From its pendulous position and free arterial supply the blood current is slow and the organ is in a bath of slowly moving blood. No satisfactory reason, however, is forthcoming to explain the advantages of the position but for the fact that these advantages are real we may accept the assurance of natural selection.

* Quoted by
Jacobson

It is possibly connected with a necessity in some animals that secretion should occur at a certain pressure, and this pressure is attained by introducing the resistance of gravity to the flow into the Vas Deferens. This is, however, as speculative as the other supposed reasons for the position.

The necessity being real it is provided for:

1. By the formation of a canal.
2. By the development in connection with this of a process of peritoneum which prepares the way for it.
3. By the provision of a fibro muscular structure which guides the organ and in all probability exercises a degree of traction by its shortening.

(V)

The CAUSE of ARREST in DESCENT.

By some writers the causes of arrest in the descent of the testicle have been sought outside the organ itself and its normal surroundings and attachments. For instance intra uterine peritonitis has been credited in some instances with the retention by means of adhesions between the testicle and adjacent viscera.

* Wood has related a case where the testis was connected with the sigmoid flexure by bands of adhesion and retained by them in the iliac fossa, the adhesions having apparently arisen in connection with some inflammatory process, probably tubercular.

^x Transactions
Patholog. Soc.
vol. VIII p. 265

In the great majority, however, of cases that have been investigated on the operating table and in the postmortem room no such adventitious and extraneous cause has been discovered.

In searching for the usual cause of this retention it is important to observe the commonest position in which the undescended organ is found. In the cases here recorded the cruro-scrotal are as common as the others combined, and the inguinal commoner than the abdominal, the proportions being 17, 10 & 7. This proportion differs considerably from that observed by other authors who have found the inguinal position most common. I have not been able,



however, to find any statistics in support of this opinion. If my own numbers are representative of the usual proportion they are sufficient to disprove the theory that an unusual narrowness of the external ring is a common cause of the incomplete descent. Not only is this the case but in most if not all of the instances where the testis was above the level of the ring, the condition of the latter was examined with the finger and in no case was any particular narrowness of the ring found, with one exception the case of complete cryptorchism in which there was no definite ring to be felt at all on either side; and here the testes were not even in the inguinal canal so that the malformation in the region of the ring can have had nothing to do with their position.

The examination of all these cases has confirmed over and over again the opinion that narrowness of the ring as a cause of retention is quite theorætical and cannot be supported by observations as far at least as the general run of cases is concerned. The examination of adult cases is of no significance in regard to this question, as a useless ring would naturally tend to become narrower.

Deficiency in the function or structure of the gubernaculum is a commonly accepted cause of arrest.

The view that has been expressed in the last chapter on the part played by this structure in the descent of the testis, if correct, makes it difficult to conceive of a deficiency in the gubernaculum acting alone in this way. Unfortunately it was not possible for the writer with the exception of one case to study the gubernaculum by dissection. In this case (Table I case 6) there was a well marked plica gubernatrix attached to the lower part of the testis and extending downwards from this for about $\frac{3}{4}$ inch. ^{where} ~~then~~ it became lost in the structures of the upper part of the scrotum. Here at anyrate the gubernaculum was not at fault: it is not, however, intended to magnify the importance of a single case.

The value of a study of cases in youth lies in the possibility of avoiding the considering as an efficient cause of retention certain conditions which naturally follow retention. I allude to other supposed causes the authority for which have rested on the dissection of adult cases; for instance shortness of the vas deferens or of the vessels. Such a state of affairs if found in adult cases cannot legitimately be put forward as explanatory of the condition as they may very well be only consequences. If, however, such a condition is found in infancy and

early youth it probably has some bearing on the subject.

Now in all cases of inguinal and cruro-scrotal retention there is a resistance to be felt against traction downwards and by traction the upper attachments of the testis are made taut. This would apparently then offer a legitimate explanation of the retention in these cases were it not for two reasons.

Firstly in none were these upper attachments actually extended to their full extent, that is to say no testis was found retained in the sense that by traction it could not be brought down from $\frac{3}{4}$ inch to about $\frac{1}{2}$ inch lower: e.g. it was possible to draw down some of the inguinal cases into the upper part of the scrotum; there was then no evidence that the testicle had descended to the full extent allowed by its vessels.

Secondly we have no physiological warrant for conceiving of the vessels as capable of resisting migration; there is no analogue for such a function. The vessels would appear in all situations to accommodate themselves to organs and there is no embryological limit for their development; both under physiological and pathological conditions they apparently adapt themselves to requirements, and in the writers opinion to

conceive of them as capable of acting as a cause of retention is unwarrantable in view of their behaviour in all other situations. By far the most important facts as throwing light on the question of the causes of arrest, are the observations on associated deformities, and of these those connected with the processus Vaginalis.

We have seen in the chapter on the Anatomy of descent that the formation of this process is a preliminary to the descent of the testicle and is not dependent on it; not, in other words carried down by the testicle in its descent.

In Table I we have therefore not only absence of the testicle on one side but absence of the independently developed processus vaginalis.

In Table II we find a delayed closure of the processus vaginalis in seven of the ten cases, and in Table III in six out of the 17 cases. Thus in all the three classes of cases incomplete development of the processus vaginalis is very common and proportionately so as the descent of the testicle is deficient.

Turning to the other associated deformities we find 8 cases in which the undescended testicle was small speaking comparatively and usually soft in

consistence. In six of these the age was under two years so that the condition can hardly have been in consequence of the non descent; in fact we have seen that such secondary degeneration has only been found microscopically in cases after puberty. It is therefore a deformity independent of descent but in a considerable proportion of cases (8 in 27 excluding the abdominal cases) associated with it.

Thirdly as a not infrequent concomitant we find a degree of hypospadias, in five cases. The worst case of this was in No 4 Table I where the descent of the testes was greatly arrested on both sides one only being palpable and that in the inguinal canal. Hypospadias then was present in about one in seven of the cases.

From a consideration of these associated deformities we are justified I think in stating that

- " delayed descent of the testicle in the great
- " majority of instances does not occur singly but is
- " associated with other structural peculiarities of
- " the testicle and other organs developmentally
- " connected with it "

In searching then for a cause of undescended testis theories which are unable at the same time to explain these associated deformities must be discarded

For example it is impossible to accept the theory of an undeveloped or deformed gubernaculum, as singly and as it were unassisted, to be capable of accounting for all or the majority of these cases; for most authors are agreed that this structure has no connection with the formation of the processus vaginalis and it certainly can have no influence on an undeveloped condition of the testicle, or the urethra and scrotum in hypospadias.

To find a sufficient cause it is necessary to proceed backwards into the uncertain and dark paths of embryology and to rely on some conceived deficiency either in physiological stimulus or in structural integrity in those parts in the embryo concerned in the evolution of the genito urinary organs.

Many if not the majority of these cases including the concomitants can be explained on the theory of reversion, and the deficient physiological stimulus or structural integrity spoken of is in all probability of this nature and origin.

If the matter may be looked at in this light an undeveloped gubernaculum is only an incident in and a part of the combination of deformities which is to be found in these cases, and

the doctrine which would cast on this structure the onus of the deformity is as unsound as that which we discussed in the previous chapter which conceived of it as the efficient and sufficient cause of normal^{mal} descent.

Arrested descent of the testicle in this way comes into line with other congenital deformities such as imperforate anus, harelip and the like, and in the usual cases no accidental nor incidental cause has been shewn to be capable of explaining the condition; nor can be theoretically conceived of as the sufficient and active agent in its production.

The observation that it is a compound and not a simple deformity finds an analogue in many other developmental errors, e.g. in the association of extroversion of the bladder with a rudimentary and deformed penis and scrotum.